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Controlling light on the nanoscale: Colloidal quantum-well lasers and strong plasmon – quantum dot coupling

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My research focuses on the dynamical processes that occur when light interacts with semiconductor nanocrystals, metal nanoparticles, and assemblies of these particles. The interaction between light and these nanoparticles depends on their size and shape, enabling a wide range of new and emerging applications. Enabling these applications will require an understanding of the processes by which the particles convert incident optical energy into other forms of energy, and how these processes relate to nanoscale structure. I will discuss two of my recent attempts to understand and take advantage some of these processes in order to enable future optical information processing: (1) Flat, thin semiconductor nanocrystals, or nanoplatelets, can be used to construct lasers with record low thresholds. (2) Coherent coupling of plasmonic metal nanoparticles has the potential to enable optical modulation on the nanoscale, at high speeds, and with low power consumption.